

SORPTION AND TRANSPORT BEHAVIOURS OF HEAVY METALS OF  
LANDFILL LEACHATE IN SOIL AT KHAM BON VILLAGE, MUANG  
DISTRICT, KHON KAEN PROVINCE, NORTHEAST THAILAND

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A Dissertation Submitted in Partial Fulfillment of the Requirements  
for the Degree of Doctor of Philosophy Program in Environmental Management  
(Interdisciplinary Program)

Graduate School Chulalongkorn University

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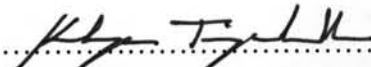
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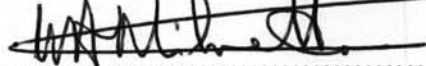
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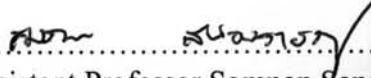
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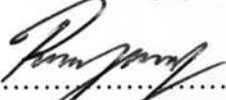
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วัตถุประสงค์ของการทดลอง เพื่อศึกษาพฤติกรรมการดูดซับโลหะหนักจากหลุมฝังกลบ  
 ซึ่งกระทบต่อคุณสมบัติทางกายภาพและเคมีของดินในแหล่งฝังกลบและพื้นที่ใกล้เคียง การศึกษา  
 ประกอบด้วย การดูดติดผิวและการปลดปล่อยของโลหะหนัก การเคลื่อนที่ของโลหะหนักในดิน  
 ตลอดจน การศึกษารูปต่างๆของสารประกอบโลหะหนักที่รวมตัวกับดิน การศึกษาสภาพแหล่งฝัง  
 กลบขยะ ได้ทำการศึกษาตัวอย่าง น้ำชะขยะ ดิน น้ำผิวดินและน้ำใต้ดิน โลหะหนักที่ทำการศึกษา  
 ได้แก่ ตะกั่ว สังกะสี โครเมียม แคดเมียม และ ทองแดง นอกจากนี้ ดินเหนียวปนทรายแป้ง ดิน  
 ทรายและดินทรายปนทรายแป้ง ได้ถูกคัดเลือกเป็นตัวแทนในการศึกษาพฤติกรรมการดูดซับโลหะ  
 หนัก จากน้ำชะขยะจริง และโลหะหนักจากน้ำชะขยะสังเคราะห์ โดยศึกษาพฤติกรรมการดูดติดผิว  
 แบบโลหะเดี่ยว และ โลหะผสม ผลการศึกษาพฤติกรรมการดูดซับโลหะหนักกับไอโซเทอมการ  
 ดูดติดผิวแบบเชิงเส้น แบบ ฟรอนลิช และ แบบแลงมัวร์ และการศึกษาการเคลื่อนที่ของโลหะหนัก  
 ในดิน ทั้งจากน้ำชะขยะจริงและน้ำชะขยะสังเคราะห์พบว่าไปในทิศทางเดียวกัน โดย สามารถ  
 ลำดับความสามารถในการดูดซับของโลหะหนักดังนี้  $Pb > Zn > Cr > Cd > Cu$  นอกจากนี้ยังพบอีก  
 ว่า ความสามารถในการดูดซับโลหะหนักของดิน ขึ้นอยู่กับคุณสมบัติทางด้านกายภาพและเคมีของ  
 ดิน ได้แก่ ค่าการแลกเปลี่ยนประจุ (CEC) ปริมาณสารอินทรีย์ และปริมาณแร่ดินเหนียวในดิน เมื่อ  
 เปรียบเทียบ ความสามารถในการดูดซับโลหะหนัก ในน้ำชะขยะจริงและน้ำชะขยะสังเคราะห์ ของ  
 ดิน พบว่า ดินมีความสามารถในการดูดซับโลหะหนัก จากน้ำชะขยะสังเคราะห์ ได้มากกว่าจากน้ำ  
 ชะขยะจริง สามารถอธิบายได้ว่า สารอินทรีย์ในน้ำชะขยะจริงจะรวมตัวเป็นสารประกอบเชิงซ้อน  
 กับโลหะหนัก มีผลทำให้ไปลดความสามารถในการดูดซับโลหะหนักกับผิวดิน จึงเปรียบเสมือน  
 เป็นตัวเร่งการเคลื่อนที่ของโลหะหนักให้เคลื่อนสู่สิ่งแวดล้อมได้มากขึ้น จากการศึกษา พฤติกรรม  
 การปลดปล่อย และรูปต่างๆของสารประกอบโลหะหนักในดิน พบว่า แคดเมียม มีโอกาสที่จะ  
 เคลื่อนที่สู่สิ่งแวดล้อมตัวได้ง่าย กว่าโลหะหนักตัวอื่น จากการศึกษาสรุปได้ว่า ตะกั่วและสังกะสีถูก  
 ดูดซับไว้ดินได้มากกว่าโลหะหนักตัวอื่นๆ ในขณะเดียวกัน โครเมียม แคดเมียม ตลอดจนทองแดง  
 มีโอกาสเคลื่อนที่ปนเปื้อนสู่น้ำผิวดินและน้ำใต้ดินได้ง่าย

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ลายมือชื่ออาจารย์ที่ปรึกษาร่วม..... *WATANA*

## 4689697920 : MAJOR ENVIRONMENTAL MANAGEMENT  
 KEY WORD: HEAVY METALS / LEACHATE / KHON KAEN / SOIL  
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UDOMPORN CHUANGCHAM : SORPTION AND TRANSPORT  
 BEHAVIORS OF HEAVY METALS OF LANDFILL LEACHATE IN  
 SOIL AT KHAM BON VILLAGE, MUANG DISTRICT, KHON KAEN  
 PROVINCE, NORTHEAST THAILAND THESIS ADVISOR : ASSOC.  
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 ASSOC. PROF. PUNYA CHARUSIRI, Ph.D., WILLIAM MILNE-  
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This study aimed to investigate the behaviors of sorption and transport of heavy metals contaminated in landfill leachate affected by the physical and chemical characteristics of soil at Kham Bon landfill site and its vicinity. The study methodology consisted of landfill characterization, sorption and transport of heavy metals by batch (adsorption and desorption) and column experiment as well as Selective Sequential Extraction (SSE). Landfill site characterization included the analysis of leachate, soil, groundwater and surface water. The studied heavy metals were Pb, Zn, Cd, Cr and Cu. Soil used in this study was taken from the landfill site, of which the property of silty clay loam, sand and loamy sand. Actual leachate and synthetic leachate with monometal and mixed metals were conducted. The results of the heavy metals sorption in soil, both actual leachate and synthetic leachate mostly exhibited the sequence of adsorption as  $Pb > Zn > Cr > Cd > Cu$  for both batch (indicated by Linear, Freundlich and Langmuir isotherms) and column tests. Desorption test indicates Cd was easier extracted than other heavy metals, followed by Cu, Cr, Zn and Pb. SSE representing the heavy metals bounded to soil showed that cadmium was observed as an exchangeable fraction. The adsorption capacity from synthetic leachate was more effective than the adsorption capacity from actual leachate. The physicochemical properties soil (cation exchange capacity, clay content and organic matter) reflected the behavior of heavy metals adsorption. Evidently, the organic and inorganic substances containing in landfill leachate play an important role in promoting the mobility of heavy metals in soil. Other factors influencing adsorption are pH and alkalinity. These factors induced precipitation in adsorption process. In summary, the study indicates that Pb and Zn were potentially accumulated in soil profile while Cr, Cd and Cu were possibly released to the groundwater and surface water. From the heavy metals sorption behavior, it is feasible to remediate contaminated soil accordingly.

Field of study: Environmental Management  
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## CONTENTS

	Page
ABSTRACT IN THAI.....	iv
ABSTRACT IN ENGLISH.....	v
ACKNOWLEDGEMENT.....	vi
CONTENTS.....	vii
LIST OF FIGURES.....	xi
LIST OF TABLES.....	xiv
<b>CHAPTER 1 INTRODUCTION.....</b>	<b>1</b>
1.1 Background Information.....	2
1.2 Description of the Study Area.....	3
1.2.1 Study Area.....	3
1.2.2 Topography and Drainage Systems.....	3
1.2.3 Existing Monitoring Wells in the Municipal Landfill Site.....	3
1.3 Geology of Khon Kaen Landfill.....	4
1.3.1 Geographical Settings.....	4
1.3.2 Geologic Settings.....	5
1.4 Objectives.....	6
1.5 Hypotheses.....	6
1.6 Scope of Study.....	6
1.7 Expected Output.....	7
<b>CHAPTER II LITERATURE REVIEWS.....</b>	<b>8</b>
2.1 Site Characterization.....	8
2.2 Leachate Characterization.....	10
2.2.1 Leachate Generation.....	10
2.2.2 Leachate Composition.....	10
2.2.3 Leachate Transport Mechanisms.....	11
2.2.4 Leachate Effects.....	11
2.2.5 Leachate Treatments.....	12
2.3 Behavior of Heavy Metals in Soil.....	12
2.3.1 Fate of Heavy Metals in Soil.....	13

	<b>Page</b>
2.3.2	Adsorption of Heavy Metals in Soil..... 13
2.3.3	Processes Affecting Metals Concentrations..... 16
2.4	Sorption Isotherms..... 17
2.4.1	Mathematical Description of Sorption..... 18
2.4.2	Adsorption Isotherms..... 18
2.4.3	Isotherm Shape Interpretation..... 21
2.4.4	Partitioning Coefficient..... 23
2.4.5	Factors Affecting Metal Adsorption..... 23
2.5	Transport of Heavy Metals in Soil..... 24
2.5.1	Physical Processes..... 24
2.5.2	Chemical and Biological processes..... 25
2.6	Partition of Heavy Metals in Soil..... 27
2.7	Heavy Metals Mobility..... 29
2.7.1	Heavy Metals Mobility in Leachate..... 29
2.7.2	Heavy Metals Mobility in Soil..... 30
2.8	Heavy Metals Attenuation..... 31
2.9	Chemistry of Metals of Interest..... 32
2.9.1	Cadmium..... 32
2.9.2	Chromium..... 32
2.9.3	Copper..... 33
2.9.4	Lead..... 33
2.9.5	Zinc..... 33
2.10	Environmental Modeling..... 34
2.10.1	Visual HELP..... 30
2.10.2	HYDRUS 2D..... 36
<b>CHAPTER III METHODS OF INVESTIGATION..... 35</b>	
3.1	Landfill Site Characterization..... 35
3.1.1	Preliminary Framework..... 35
3.1.2	Landfill Site Characterization..... 35
3.1.2.1	Data Gathering..... 38



	<b>Page</b>
3.1.2.2	Reconnaissance..... 38
3.1.2.3	Subsurface Investigation..... 39
3.1.2.4	Hydrogeological Testing..... 40
3.1.2.5	Soil and Water Chemistry Analysis..... 40
3.1.3	Sampling Strategy and Analysis..... 36
3.1.3.1	Soil Samplings..... 40
3.1.3.2	Surface Water and Groundwater..... 43
3.2	Adsorption and Transport of Heavy Metals in Soil..... 44
3.2.1	Materials and Reagents..... 44
3.2.2	Batch Adsorption..... 45
3.2.2.1	Preliminary Experiment..... 45
3.2.2.2	Sorption Experiments..... 46
3.2.2.3	Desorption Experiment..... 46
3.2.2.4	Sequential extraction of sorbed metals..... 47
3.2.3	Column Experiment..... 49
3.3	Simulation of Heavy Metals Transportation..... 52
3.3.1	Visual HELP..... 52
3.3.1.1	Weather Data..... 52
3.3.1.2	Evapotranspiration Parameters..... 52
3.3.1.3	Soil and Waste Properties..... 53
3.3.1.4	Landfill Design Data..... 54
3.3.1.5	Approach for the Visual HELP Simulation..... 56
3.3.2	HYDRUS 2D..... 57
<b>CHAPTER IV LANDFILL SITE CHARACTERIZATION..... 58</b>	
4.1	Description of the Study Area..... 58
4.1.1	General Description of Kham Bon Landfill and Its Vicinity..... 58
4.1.2	Solid Wastes Disposal to Landfill Site..... 59
4.1.3	Problems of Kham Bon Landfill..... 60
4.1.4	Climate and Drainage Systems..... 60
4.2	Kham Bon Landfill Site Characterizations..... 61

	<b>Page</b>
4.2.1	Landfill Leachate Characterization..... 61
4.2.2	Soil Analysis..... 64
4.2.2.1	Physical and Chemical Properties of Soil..... 64
4.2.2.2	Distribution of Metals in Soil..... 70
4.2.3	Groundwater Analysis..... 82
4.2.3.1	Hydrogeology..... 82
4.2.3.2	Hydrogeochemistry..... 82
4.2.3.3	Heavy Metals in Groundwater..... 89
4.2.4	Surface water Analysis..... 92
4.2.4.1	Hydrochemistry..... 92
4.2.4.2	Heavy Metals in Surface Water..... 96
4.4	Landfill Leachate Production..... 96
4.5	Kham Bon Landfill Circumstance.....
<b>CHPATER V</b>	<b>SORPTION CAPACITY OF CONTAMINATED SOIL 98</b>
	<b>FOR HEAVY METALS IN KHAM BON LANDFILL</b>
	<b>LEACHATE .....</b>
5.1	Characteristics of Selected Samples..... 98
5.1.1	Selected Soil Samples..... 98
5.1.2	Landfill Leachate..... 99
5.2	Sorption Isotherms: Batch Experiments..... 99
5.2.1	Determination of Distribution Coefficient ..... 100
5.2.1.1	Monometal Isotherm..... 104
5.2.1.2	Competitive Metals Isotherms..... 111
5.2.2	Sorption Capacity of Heavy Metals by Kham Bon Soil..... 115
5.2.2.1	Monometal Isotherm..... 115
5.2.2.2	Competitive Metals Isotherms..... 118
5.2.3	Factors Controlling the Mobility of Heavy Metals in Kham Bon 121
	Soil.....
5.2.3.1	Organic and Inorganic Compound Containing in 121
	Leachate.....

	<b>Page</b>
5.2.3.2 High pH and Alkaline of Leachate.....	124
5.2.3.3 Physical and Chemical Properties of Kham Bon Soil...	125
5.2.4 Speciation of Heavy Metals by MINTEQA2.....	127
5.3 Desorption of Sorbed Metal.....	131
5.4 Selective Sequence Extraction.....	136
5.4.1 Cadmium.....	137
5.4.2 Chromium.....	137
5.4.3 Lead.....	141
5.4.4 Copper.....	141
5.4.5 Zinc.....	141
5.4.6 Mass balance calculations.....	141
<b>CHAPTER VI TRANSPORT OF HEAVY METALS FROM KHAM</b>	<b>145</b>
<b>BON LANDFILL LEACHATE IN SOIL.....</b>	
6.1 Column Experiments.....	145
6.1.1 Bromide Tracer Breakthrough Curves.....	145
6.1.2 Monometal Transport Modeling.....	146
6.1.3 Competitive Metals Transport Modeling.....	151
6.2 Environmental Implication.....	157
<b>CHAPTER VII CONCLUSION AND RECOMMENDATION.....</b>	<b>156</b>
7.1 Conclusion.....	159
7.2 Recommendation.....	162
REFERENCES.....	165
APPENDICES.....	175
APPENDIX A Data obtained from Batch Sorption Experiment.....	176
APPENDIX B Data obtained from Column Experiment.....	206
APPENDIX C Publication.....	277
BIOGRAPHY.....	290

## LIST OF FIGURES

Figure		Page
1.1	The location of the study area at Kham Bon village, Khon Kaen Province, Northeast Thailand.....	4
1.2	Location of groundwater monitoring wells in the study area.....	5
2.1	The favorable Freundlich isotherm.....	21
2.2	General classes of isotherm.....	22
2.3	Water balance components in a sanitary landfill.....	35
3.1	Flow diagram of field and laboratory investigation.....	37
3.2	The high affinity zone obtained from initial isotherm.....	44
3.3	Column design.....	47
3.4	Schematic drawing of selective sequencing extraction method.....	48
3.5	Flow chart of Visual HELP model.....	52
3.6	Kham Bon landfill profile for the application of Visual HELP model..	53
4.1	Location of the study area at Kham Bon village, Khon Kaen Province, Northeast Thailand.....	56
4.2	Percentage distributions of wastes deposited in Kham Bon landfill (Piyaprasit, 1996).....	57
4.3	Location of landfill leachate samples collected in all periods of sampling.....	62
4.4	Location of soil water samples taken in all periods of sampling.....	66
4.5	Percentage of Clay content distribution in the study area for all soil at 0-90 cm depth in the third sampling period: 0-30 cm depth (A); 30-60 cm depth (B); 60-90 cm depth (C).....	67
4.6	Organic matter of all soil at 0-90 cm depth in the third sampling period: 0-30 cm depth (A); 30-60 cm depth (B); 60-90 cm depth (C)..	68
4.7	Cation exchange capacity of all soil at 0-90 cm depth in the third sampling period: 0-30 cm depth (A); 30-60 cm depth (B); 60-90 cm. depth (C).....	69

Figure	Page
4.8	Heavy metal concentrations at 0-15 cm depth in the first sampling period ..... 71
4.9	Heavy metals concentration at 0-15 cm depth (A) and 15-30 cm depth (B) in the second sampling period..... 72
4.10	Heavy metals concentration at 0-30 cm depth (A), 30-60 cm depth (B), and 60-90 cm depth (C) in the third sampling period..... 73
4.11	Heavy metal concentrations at 0-15 cm depth in the first sampling period: Cr (A); Pb (B); Cu (C); Zn (D)..... 74
4.12a	Concentration of Cr at 0-15 cm depth (A) and 0-30 cm depth (B) in the second sampling period..... 75
4.12b	Concentration of Pb at 0-15 cm depth (A) and 0-30 cm depth (B) in the second sampling period..... 75
4.12c	Concentration of Cu at 0-15 cm depth (A) and 0-30 cm depth (B) in the second sampling period..... 76
4.12d	Concentration of Zn at 0-15 cm depth (A) and 0-30 cm depth (B) in the second sampling period..... 76
4.13a	Concentration of Pb at 0-15 cm depth (A), 15-30 cm depth (B), and 60-90 cm depth (C) in the third sampling period ..... 73
4.13b	Concentrations of Cr at 0 at 0-15 cm depth (A), 15-30 cm depth (B), and 60-90 cm depth (C) in the third sampling period..... 78
4.13c	Concentrations of Cu at 0-15 cm depth (A), 15-30 cm depth (B) , and 60-90 cm depth (C) in the third sampling period..... 79
4.13d	Concentrations of Zn at 0-15 cm depth (A), 15-30 cm depth (B), and 60-90 cm depth (C) in the third sampling period..... 80
4.14	Location of groundwater monitoring wells in the study area..... 83
4.15	Geologic section along A-A' showing stratigraphy and hydrogeology of the Kham Bon landfill, KhonKaen..... 83
4.16	Groundwater flow direction in the shallow aquifer (A) and the deep aquifer (B) in the study area..... 84

<b>Figure</b>	<b>Page</b>
4.17 Hydrochemical facies of groundwater in all sampling periods in the study area.....	88
4.18 Heavy metals concentration of groundwater monitoring wells in the first period of sampling (A), the second period of sampling (B) and the third period of sampling (C) in the study area.....	90
4.19 Location of surface water samples taken in all periods of sampling.....	93
4.20 Location of landfill leachate samples collected in all periods of sampling.....	97
4.21 Profile structure for the first of simulations.....	98
4.22 Profile structure for the second of simulations.....	99
4.23 Profile structure for the third of simulations.....	95
5.1 Location of three selected soil samples in the study area for sorption experiment.....	98
5.2 Monometal sorption isotherms at 25 °C with initial pH 8.16 for retention of Cd, Cr, Cu, Pb and Zn by three soils treated with actual leachate: KBS-1; KBS-2 and KBS-3.....	101
5.3 Monometal sorption isotherms at 25 °C with initial pH 8.16 for retention of Cd, Cr, Cu, Pb and Zn by three soils treated with actual leachate: KBS-1; KBS-2 and KBS-3.....	106
5.4 Competitive sorption isotherms at 25 °C with initial pH 8.16 for retention of Cd, Cr, Cu, Pb and Zn by three soil treated with actual leachate : KBS-1; KBS-2, and KBS-3.....	112
5.5 Competitive sorption isotherms at 25 °C with initial pH 8.16 for retention of Cd, Cr, Cu, Pb and Zn by three soil treated with synthetic leachate : KBS-1; KBS-2, and KBS-3.....	113
5.6 Monometal sorption isotherms at 25 °C with initial pH 8.16 for retention of Cd, Cr, Cu, Pb and Zn by KBS-1 soil in actual leachate compared to synthetic leachate.....	122

<b>Figure</b>		<b>Page</b>
5.7	Monometal sorption isotherms at 25 °C with initial pH 8.16 for retention of Cd, Cr, Cu, Pb and Zn by KBS-2 soil in actual leachate compared to synthetic leachate.....	123
5.8	Monometal sorption isotherms at 25 °C with initial pH 8.16 for retention of Cd, Cr, Cu, Pb and Zn by KBS-3 soil in actual leachate compared to synthetic leachate.....	124
5.9	Percentage of desorption of sorbed metals in three soil treated with actual leachate : KBS-1 (a); KBS-2 (b), and KBS-3 (c).....	132
5.10	Percentage of desorption of sorbed metals in three soil treated with synthetic leachate : KBS-1 (a); KBS-2 (b), and KBS-3 (c).....	133
5.11	Percentage of desorption of sorbed metals in three soil treated with actual leachate in competitive system : KBS-1 (a); KBS-2 (b), and KBS-3 (c).....	134
5.12	Percentage of desorption of sorbed metals in three soil treated with synthetic leachate in competitive system : KBS-1 (a); KBS-2 (b), and KBS-3 (c).....	135
5.13	Distribution of heavy metals in natural three soils.....	138
5.14	Distribution of heavy metals in three soils treated with actual Leachate.....	139
5.15	Distribution of heavy metals in three soils treated with synthetic Leachate.....	140
6.1	Breakthrough of Bromide tracer transport though soil column.....	147
6.2	Breakthrough curves of Cd, Cr, Pb, Cu, and Zn of KBS-2 soil treated with actual leachate.....	147
6.3	Breakthrough curves of Cd, Cr, Pb, Cu, and Zn of KBS-3 soil treated with actual leachate.....	148
6.4	Breakthrough curves of Cd, Cr, Pb, Cu, and Zn of KBS-2 soil treated with synthetic leachate.....	149
6.5	Breakthrough curves of Cd, Cr, Pb, Cu, and Zn of KBS-3 soil treated with synthetic leachate.....	150

<b>Figure</b>		<b>Page</b>
6.6	Breakthrough curves of competitive metals of KBS-2 soil treated with actual leachate.....	152
6.7	Breakthrough curves of competitive metals of KBS-3 soil treated with actual leachate.....	153
6.8	Breakthrough curves of competitive metals of KBS-2 soil treated with synthetic leachate.....	154
6.9	Breakthrough curves of competitive metals of KBS-3 soil treated with actual leachate.....	155



## LIST OF TABLES

Table		Page
3.1	Physico-chemical analyses of soil samples.....	42
3.2	Detection limit of each metal for AAS analysis.....	42
3.3	Physico-chemical analyses of all liquid samples.....	43
3.4	Experimental conditions design for preliminary study.....	46
3.5	Experimental conditions design for sorption study.....	47
3.6	Sequential extraction procedure for speciation of heavy metals.....	48
3.7	Experimental conditions for column study.....	51
3.8	Input parameters for Visual HELP Model Application in Kham Bon Landfill.....	53
3.9	Important Parameters input in the Visual HELP model.....	54
4.1	Chemical characteristics of landfill leachate in all samplings.....	63
4.2	Heavy metals concentration in Soil collected in three sampling time...	70
4.3	Chemical properties of groundwater collected in the first period of sampling.....	85
4.4	Chemical properties of groundwater collected in the second period of sampling.....	86
4.5	Chemical properties of groundwater collected in the third period of sampling time.....	87
4.6	Chemical properties of surface water collected in the first period of sampling time.....	94
4.7	Chemical properties of surface water collected in the second period of sampling time.....	94
4.8	Chemical properties of surface water collected in the third period of sampling time.....	95
5.1	Physical and chemical properties of soil collected from landfill site its vicinity.....	102
5.2	Background concentration of heavy meals in soil samples.....	102
5.3	Chemical characteristics of influent leachate taken for batch sorption and column test.....	103

<b>Table</b>	<b>Page</b>
5.4 Linear isotherm parameters of KBS-1, KBS-2 and KBS-3 soil induced from monometal sorption solution at 25 °C with initial pH 8.16.....	108
5.5 Affinity sequence of Linear isotherm of KBS-1, KBS-2 and KBS-3 soil induced from monometal sorption at 25 °C with initial pH 8.16...	109
5.6 Linear isotherm parameters of KBS-1, KBS-2 and KBS-3 soil induced from competitive metals sorption at 25 °C with initial pH 8.16.....	114
5.7 Affinity sequence of Linear metals isotherm of KBS-1, KBS-2 and KBS-3 soil induced from competitive metals 25 °C with initial pH 8.16.....	114
5.8 Isotherm parameters of KBS-1, KBS-2 and KBS-3 soil induced from monometal sorption in actual leachate solution at 25 °C with initial pH 8.16.....	115
5.9 Freundlich and Langmuir isotherm parameters of KBS-1, KBS-2 and KBS-3 soil induced from monometal sorption in synthetic leachate solution at 25 °C with initial pH 8.16	116
5.10 Affinity sequence of Langmuir isotherm of KBS-1, KBS-2 and KBS-3 soil induced from monometal sorption at 25 °C with initial pH 8.16.....	117
5.11 Freundlich and Langmuir isotherm parameters of KBS-1, KBS-2 and KBS-3 soil induced from competitive metals sorption in actual leachate solution at 25 °C with initial pH 8.16.....	118
5.12 Freundlich and Langmuir isotherm parameters of KBS-1, KBS-2 and KBS-3 soil induced from competitive metals sorption in synthetic leachate solution at 25 °C with initial pH 8.16.....	119
5.13 Affinity sequence of Freundlich and Langmuir isotherm of KBS-1, KBS-2 and KBS-3 soil induced from competitive metals sorption at 25 °C with initial pH 8.16.....	119

<b>Table</b>		<b>Page</b>
5.14	$K_R$ values calculated from Langmuir constant parameters of three soils treated with actual leachate and synthetic leachate.....	120
5.15	MINTEQA2 calculated saturation indices for selected metal mineral phase, based on the average equilibrium data during their interaction with actual leachate and synthetic leachate.....	129
5.15	MINTEQA2 calculated saturation indices for selected metal mineral phase, based on the average equilibrium data during their interaction with actual leachate and synthetic leachate.....	130
6.1	Experimental conditions for column studies.....	146
6.2	Parameters calculation from column test.....	156
6.3	Retardation factor calculated from sorption experiment.....	157
6.4	Retardation factor calculated from transport model.....	158

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